PureLine™

WHITE PAPER
VIRUS DECONTAMINATION

N95 Respirator Mask Decontamination

Prototype testing

PureLine R&D Staff , Virus Decontamination
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For additional information, please contact
PureLine at info@pureline.com
847.963.8465

Executive Summary: The Issues

No issue is more important for health care workers across the United States as they face a shortage of personal protective equipment (PPE) to avoid contamination as they battle coronavirus/Covid-19.

Given the shortage of medical equipment to keep frontline providers safe, PureLine set out to test the efficacy of PureLine's Chlorine Dioxide gas (ClO_2) decontamination process on N95 masks. The tests were conducted in a chamber utilizing PureLine's PureVista™ (PV) gas generation technology.

Results

The results of this testing are as follows:

1. ClO_2 gas successfully penetrated the mask indicated by the sensor applied to the test mask and a 6 log kill was achieved.
2. The integrity of the test mask was not compromised from the ClO_2 gas treatment process. The ClO_2 dosage required to kill all forms of microbial life including bacteria and viruses is approximately 500 ppm-hours. The ClO_2 dosage used during testing was approximately 3,000 ppm-hours to determine if an increased dose would have a negative effect on the mask integrity. The higher dose determined a very slight discoloration that immediately disappeared once the masks were removed from the ClO_2 test chamber. Furthermore, the elastic, staples, and forming bar showed no signs of deterioration.

G Stearothermophilus spore strips containing 1.7 x 106 spores per strip were incubated and no growth resulted after culturing per the spore strip manufacturer instructions. Therefore a 6 log reduction (99.9999% reduction) was confirmed.

Recommendations

Recommendation is to use a PureLine PureVista2 (2 gram) unit for every two cubic feet of space within a sealed container or cabinet to masks for the gas decontamination process. Masks should be separated so maximum surface area is exposed to each mask. Follow PureVista2 use instructions that can be found at https://www.pureline.com/virus-decontamination/purevista-instructional-materials/ or by emailing info@pureline.com to discuss with a PureLine professional or receive the instructions by email.

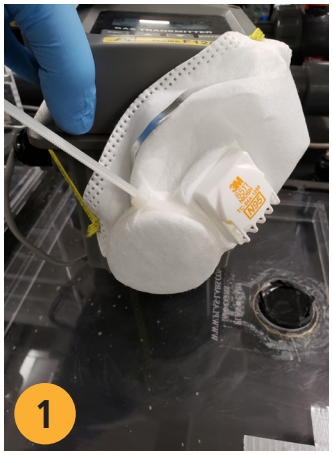
Testing –>

Test 1

Test 1 involves covering and sealing a mask to one of our ClO_2 gas sensors. Please see photo labeled 1 to see how we accomplished this.

A zip tie was used to secure the mask around the sensor head to ensure the only path for the ClO_2 gas to travel was through the filter membrane. 1

As indicated in the photo, the reading was 0 ppm when initially placed into the test chamber. 2 3



The sensor and mask were placed in a 1 cubic foot acrylic test chamber along with the PureVista that released a small amount of ClO_2 gas. This created an atmosphere with elevated ClO_2 gas levels, with no additional air movement. 4

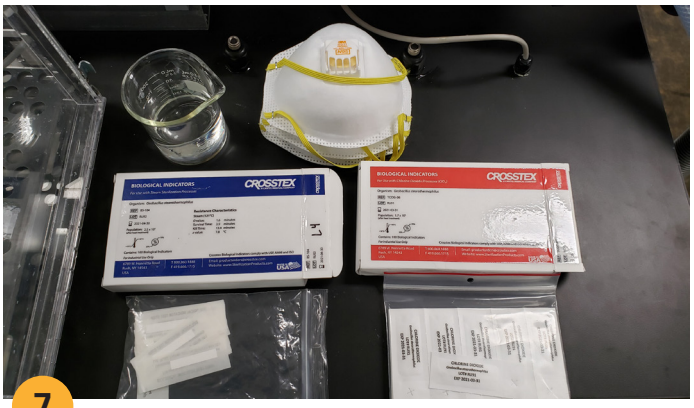
Within seconds, the sensor began to register ClO_2 gas and then quickly detected over 200 ppm through the mask.

This indicates the ClO_2 gas (which obeys ideal gas laws) is passing through the very porous filter via diffusion. There was no added pressure or air current required to get the gas to diffuse into the air inside and beyond the mask.

Screen shots of a 55 second video showing the ClO_2 level quickly rising to over 200ppm. 5 6

Test 2

It was evident that the ClO_2 gas had little resistance passing through the mask filter, Test 2 placed the biological indicators in the masks, stack the masks together, and subject them to a decontamination cycle in the test chamber. This would determine if the ClO2 would achieve 6 log kill via the gas passing through the mask. 7



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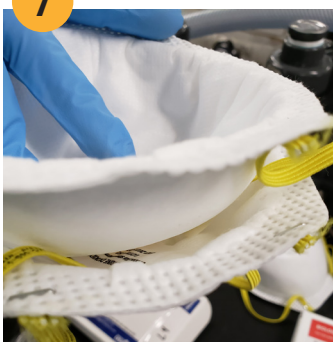
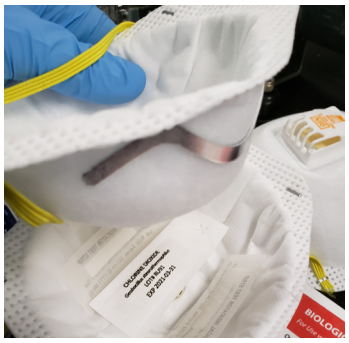
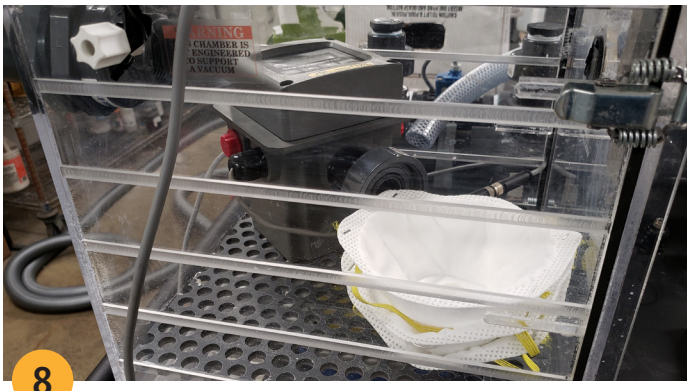
The ClO_2 gas concentration was held at 1000 pm for almost 3 hours, which is significantly higher then what will be required but PureLine wanted to disprove any doubts regarding material degradation.





The masks with the BI's in between were placed in the chamber with a ClO_2 sensor and the PV. A control set of BI's were left in the lab outside the chamber to verify the untreated BI's are still viable. 8



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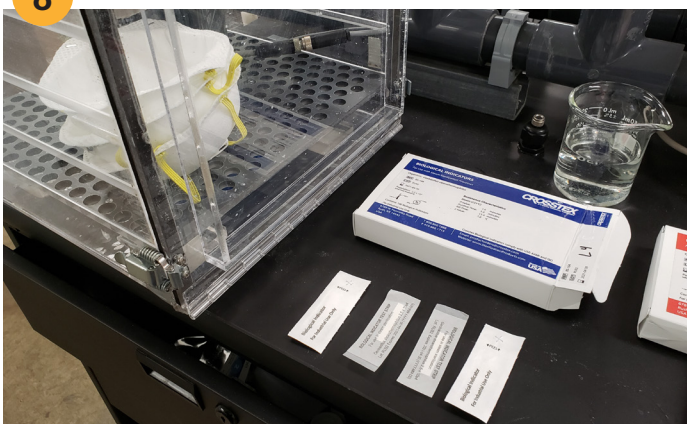
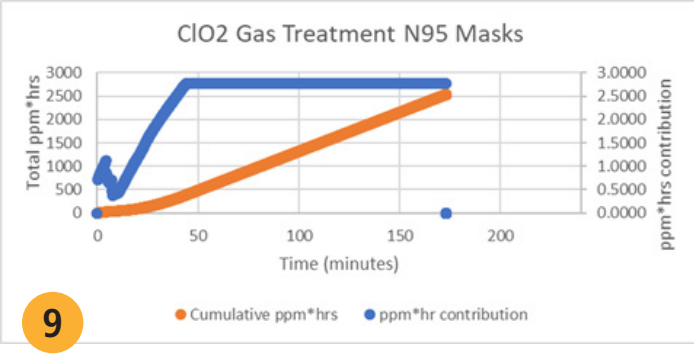


The gas concentration was monitored and logged throughout the test to measure the total contact time in ppm*hrs. The graph is the data from the ClO_2 sensor. 9 The treatment resulted in ~2500ppm *hrs. This is sufficient to kill the spores on the BI.



Typically less than 500ppm*hrs is required to inactivate envelope viruses. Again this test was design to show 4-6log spore reduction and observe the masks for any material issues with the gas treatment. **If no damage is seen at these treatment levels, lower levels will not be a concern.**

The BI's have been sent out for culturing to determine the if a 6 Log kill was achieved. The masks did not show any signs of deterioration (elastic was tested, staples and forming bar were not affected). There was some yellow color evident when the masks were first removed quickly faded once they were removed from the ClO_2 container.

The center bottom mask is the control mask, not treated. 10

It is a slight brighter white than the treated mask immediately after treatment. Within 10 minutes there was no noticeable difference in the mask colors. Likely the some ClO_2 bound to the fibers and had to release to the atmosphere once there was not more ClO_2 present.

Results confirm a 6 log kill was achieved.